

**USDA TELECOMMUNICATIONS NETWORK  
ANALYSIS**

**COMPARATIVE ASSESSMENT  
OF  
NETWORK MODELING TOOLS**

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Office of Information Resources Management  
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Fort Collins, CO 80524

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**Pilot Research Associates, Inc.**  
1953 Gallows Road, Suite 350  
Vienna, VA 22182

(703) 883-2522

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## **1. GENERAL CONSIDERATIONS**

Today's communications networks are expanding in scope and diversity of service. As a result, the planning of such networks is increasingly more challenging. There are network monitoring tools capable of collecting traffic data, discovering and displaying network topologies providing valuable network information. However, there is still a great need for network analysis and optimization tools that allow new networks or proposed changes to existing ones to be quickly evaluated before committing to a course of action.

There are numerous network tools on the market addressing various aspects of network analysis. The variety spans from network documenting tools to very sophisticated design tools that can perform network simulation and optimization based on cost and performance. The cost of such tools varies proportionally from few hundred dollars to more than hundred thousand dollars.

In today's environment, one can expect a network analysis tool to: 1) insure that the network has the "just-right" capacity to meet the requirements; 2) help avoiding unplanned configuration changes that may be costly to the network operator; 3) allow the system professional to run "what if" scenarios. Those expectations are addressed by four basic functions: network description (existing or new), simulation, optimization, and presentation. Further functionality distinctions can be made within each of those basic functions. Network performance results are obtained from simulation and optimization. Network optimization may be performed on a performance and/or cost basis. The network analysis tools on the market today support one or more of these functions within the scope of their network support (e.g.: some tools may address only the upper Management layers, while other may address the traffic from a protocol viewpoint, but not the physical link).

The USDA Telecommunications Services Division (TSD) needs the capability to evaluate alternative configurations for regional networks to access the FTS2000 long distance network. This requirement is especially critical for high speed data networks, such as Frame Relay, Fractional T1 and Asynchronous Transfer Mode (ATM), whose use is growing rapidly within USDA. To this end, PILOT was tasked to assess the capabilities of commercially available telecommunications network analysis tools capable of optimizing (based on cost and performance) routing in both inter- and intra-Local Access Transport Area (LATA) networks.

## **2. NETWORK MODELING TOOL ASSESSMENT**

### **2.1 ASSESSMENT STRATEGY**

The comparative assessment of network modeling tools that will satisfy USDA's requirements is based on the criteria described in the *Network Modeling Tools Evaluation Criteria* of Appendix A. PILOT has identified the commercially available network development tools and acquired information for their comparative assessment.

The initial identification of tools and vendors was made simply on the availability of a product capable of analyzing Wide Area Networks (WAN) configurations in some manner. This has helped prevent the premature rejection of possible candidates.

The reduction of this list to a manageable number for closer scrutiny is based on the support or lack thereof for the essential criteria — the mandatory items, such as optimization capability based on cost and performance.

The tools that remain are reviewed and then ranked based on the criteria defined in the *Network Modeling Tools Evaluation Criteria*. PILOT proposes to use a “scoring” system in this ranking. The criteria are divided into four categories with a ‘weight’ assigned to each, representing what we think is an appropriate relative importance. Each feature is given a relative score against the ‘weight’. The ‘weight’ also represents the maximum score that can be assigned to a tool for a given category. The proposed criteria categories and ‘weights’ are listed below:

- Tool features — (total 80%)
  - Network models supported — 15%
  - Modeling capability — 20%
  - Modeling input data capability — 15%
  - Optimization capability — 20%
  - Reporting capability — 10%
- Tool ease of use — 5%
- Vendor support — 10%
- Cost — 5%

PILOT's recommendations and presentations to USDA is based upon the results of this ranking.

### **2.2 INITIAL SYSTEMS LIST**

The criterion used to create the initial list of network tools is the availability of a product capable of analyzing WAN configurations in some manner. The list presents a brief description of each system and a justification of why a particular product is eliminated or retained for further consideration.

- **Abstraction Software — Prophecy**

Prophecy is a window-based visual interactive Local Area Network (LAN) and WAN networks and workflow simulation system that models network performance and resource utilization. While this tool does provide some performance optimization capabilities, it does not address cost optimization (e.g.: least-cost routing) as required by USDA.

- **Azure — Netstressor**

Netstressor is an internetwork system test suite for “pressure-testing” Internet networks. It is geared specifically for Internet networks and protocols; it does not address the USDA network modeling requirements such as Frame Relay and T1/Fractional T1.

- **Bellcore — The Planning Workbench Suite**

The Bellcore Planning Workbench software package offer capabilities to analyze traffic demands, network elements, equipment costs, performance and survivability of Synchronous Optical Network (SONET), Asynchronous Transfer Mode (ATM) and Frame Relay networks. Each member of the Workbench suite is a complete solution for a specific data network technology. However, the different tools may be integrated by utilities moving data across the Planning Tools suite. The suite is capable of modeling and optimization based on cost and performance. The Frame Relay and ATM software tools meet USDA’s essential criteria and are candidates for further evaluation.

- **CACI Products — Comnet III**

Comnet III is an object-oriented capacity planning and performance prediction tool used in the design and ongoing maintenance of LAN, Metropolitan Area Network (MAN), WAN voice and data communication networks. Based on the description of the network topology, access protocols, traffic and routing algorithms, the tool simulates the operation of the described network, providing a measure of network performance such as response times, network throughput, node and link utilization, blocking probabilities and other traffic statistics. Comnet III is a very sophisticated simulation tool which provide detailed network performances figures. Comnet III does not provide the capability to address to USDA’s cost optimization requirement. CACI Products has currently no plan to provide such capability in Comnet III. However, the tool is designed to interface with the Network Analysis Center, Inc.(NAC)’s WinMIND tool providing the cost modeling not available on Comnet III.

- **CACI Products — Comnet Predictor**

By importing baseline data from existing network management and monitoring tools and specifying a proposed test scenario, COMNET Predictor immediately generates graphs and charts illustrating how changes such as adding users and applications or altering equipment, bandwidth and routing affecting network performance. The tool generates delay and utilization data, as well as predictions of where bottlenecks may appear. COMNET Predictor complements simulation tool, COMNET III, by quickly identifying scenarios that warrant detailed simulation studies. COMNET Predictor can then export network models to COMNET III. As for Comnet III, Comnet Predictor does not address the USDA’ cost optimization requirement.

- **Cisco** — NETSYS Enterprise/Solver

The NETSYS Enterprise/Solver family of network tools aids in problem solving management, and planning of networks. The tools are network management solutions to manage the network as a system rather than as independent devices. They use the VISTA (View, Isolate, Solve, Test, Apply) network change methodology. This feature manages changes in the network and identify the impact of such changes. The tools address mostly private networks at the protocol level (i.e.: Internet Protocol (IP), System Network Architecture (SNA), AppleTalk) rather than addressing the transport media such as Frame Relay and T1/Fractional T1. Therefore, such tools does not meet all USDA's essential criteria.

- **Digital Equipment Corporation (DEC)** — POLYCENTER Capacity Planner

This software determines the computing resources required to run applications. Its “what if” capability let users modify hardware and software characteristics to optimize system and network design. Features includes modeling for multivendor client/server systems, pre-defined characteristics of systems and network components from divers vendors. It models both LANs and WANs. While this tool provides some performance optimization capability, it does not address specifically the required transport media (i.e. Frame Relay and T1/Fractional-T1) nor service / device cost optimization.

- **GRC International** — Network VUE

Network VUE product contains an expert system for optimizing WAN networks based on cost and performance. The expert system identifies network shortfalls and suggests ways to improve performance within the user design goals and requirements. The expert system is embedded within the Network VUE tool called the Optimizer. The Optimizer utilizes other features of the tool, including telecommunications simulation, networking hardware specifications, tariff databases and network design tools to develop a tailored network design. Network VUE satisfy USDA's essential requirements and is worthy of further evaluation.

- **GRC International** — NetSolve

NetSolve is an earlier GRC International product and has similar functions than the Network VUE tool. It is designed to run on smaller IBM compatible Personal Computer (PC) platform (e.g. laptop), unlike NetWork VUE which operates in a UNIX environment. This tool is mostly an optimization tool; it does not support simulation functions nor does it support a device library as it successor does. However, this tool still meets the USDA's essential requirements.

- **Hewlett-Packard** — Openview History Analyzer/UX

This system provides real network data needed for network capacity planning. It takes advantage of HP Ease traffic-sampling capability to analyze network traffic and provide historical data of network capacity. While this system can be used to provide traffic flow to a network optimization tool, itself, does not have cost and performance optimization capabilities.

- **ImageNet** — Computer Aided Network Engineering (CANE)

CANE is a Windows NT package that assists in the planning, design and simulation of networks. The Object-oriented database can be used to define specific types of network configurations and evaluate their cost and performance. This tool is capable of fulfilling some of USDA's essential requirements. However, it is mostly a design and simulation tool and lacks essential optimization features (cost and performance) to meet USDA's requirements.

- **Interpose** — Client / Server Solution Advisor

The C/S Solution Advisor is a network management software designed to assist Information Systems (IS) professionals in understanding network capacity and cost issues (including budget, staffing, and Total Cost of Ownership (TCO)), planning upgrades, migrations, and evaluation of project costs and return on investments. This tool is targeted to the 'upper' layers of the Network Management system and does not address the service cost and performance issues associated with the network transport facilities (i.e.: Frame Relay, T1/Fractional T1 and ATM).

- **Makes Systems, Inc.** — NetMaker XA

NetMaker XA is a suite of software network decision tools that simplify tracking, reporting, analysis, accounting, planning and design tasks. NetMaker XA, integrates on a single hardware platform a set of tools capable of analyzing the impact of network changes and growth, and perform optimization based on cost and performance. The tool's Accountant software module tracks and allocate network costs as well as supporting plug-ins for a variety of tariff databases including US carriers and FTS2000. The Planner module addresses LAN/WAN performance and utilization. The NetMaker XA software suite meets USDA's essential criteria and is candidate for further evaluation.

- **Microsystems Engineering** — Sysdraw

Sysdraw is a network design and documentation tool using manufacturer-specific hardware device images. Sysdraw is mainly a documentation tool and does not provides functionality required by USDA such as network optimization.

- **Mil 3, Inc.** — Opnet

Opnet provides a software environment for modeling, simulating and analyzing the performance of communications networks, computer systems and applications, and distributed systems. While this tool provides modeling and simulation capabilities, it does not address network optimization based on service cost as required by USDA.

- **Network Analysis Center, Inc.** — WinMIND

WinMIND is a fully integrated network modeling, pricing and performance analysis software package capable of pricing, managing and designing local access and mesh wide area networks. The tool models, optimizes and design for end-to-end network performance and cost for different type of WAN including Frame Relay and T1/Fractional T1. It determines circuit utilization and response times using defined network traffic characteristics and volumes. Furthermore, simulation and detailed performance network analysis can be achieved with WinMIND tool's

capability to interoperate with CACI's Comnet III simulation tool. The WinMIND software network modeling tool meets USDA's essential criteria and is candidate for further evaluation.

- **Netsuite** — Netsuite Professional Design

Netsuite Professional Design provides real-time physical design validation, work orders and bills of material, network asset-tracking and reporting. This is also a tool addressing the higher layers of the Network Management systems. It does not address the service cost and performance issues related to the transport media (i.e.: Frame Relay, T1 and ATM).

- **Network Design and Analysis (NDA)** — Autonet

Autonet is set of network planning and implementation tools which perform cost analysis, network design, backbone optimization, plus inventory management, order processing and bill verification.

The *Autonet/Performance-3* is a performance modeling and analysis tool for LAN-to-LAN connections and WAN transmission facilities. From the network topology, equipment specifications, and workload profiles, the model will generate application response times and network utilization.

The *Autonet/performance-1* provides performance analysis for WANs and LANs using analytic modeling techniques (i.e.: queuing model) to analyze the performance of the networks with Synchronous Data Link Control (SDLC), Asynchronous (ASYNCR), Binary Synchronous Communication (BSC) and High-level Data Link Control (HDLC) protocols.

*Autonet/Designer* evaluates "what if" scenarios for enterprise networks, based on information provided by NDA about various services offered by telecommunications carriers. It is used to design new networks and improve existing networks to meet performance objectives, determines the cost based on tariffs and evaluate bridging options.

*Autonet/Mesh* is the backbone design tool providing the least cost mesh and hierarchical design solutions for dedicated networks.

*Autonet/Pricer* provides detailed price information on dedicated and switched networks.

Circuit costs are computed using up-to-date tariffs and store them for future reference.

This set of tool meets almost all USDA's essential requirements with the exception of Frame Relay that is not supported by the performance and network design tools. Also, each of the software package is currently a stand-alone tool and make the import/export of data from one tool to the other difficult.

- **Network Tools** — Virtual Agent Professional

Network Capture Virtual Agent scans and captures Management Information Base (MIB) and Remote Monitoring (RMON) data from Simple Network Management Protocol (SNMP) devices on an existing network. With this information, the tool builds a software-based "virtual network," composed of hubs, switches, routers, and other devices, which serves as a starting point for subsequent SNMP modeling. Each of the simulated agents maintains all the individual characteristics and configuration attributes captured during data collection, such as unique IP address, Media Access Control (MAC) address, and statistical information. This tool is designed



for network management modeling and does not address the USDA's network transport media requirements such as Frame Relay and T1/Fractional-T1.

- **Optimal Network Corp.** — Optimal Performance

The Optimal Performance tool handles optimization, capacity planning, and design of enterprise networks. The Windows-based application uses actual network statistical data collected by Network General's expert Sniffer and distributed Sniffer to generate models. From the network baseline model, analysis and simulation of the network can be done generating a list of performance optimization recommendations. While this tool addresses some of the USDA's requirements (performance optimization), the USDA's cost optimization requirement would not be met.

- **Quyen Systems, Inc.** — NetViz

NetViz is a diagramming and documenting software package that can be used to design and diagram any real or conceptual network structure consisting of interconnected objects. It is also capable of documenting telecommunications networks, computer systems, business and manufacturing processes. This system is only a documenting tool that does not provide any network modeling and optimization capabilities required by USDA.

- **Qualix Group** — TeamQuest Baseline

This tool provides real-time performance monitoring, performance analysis, trend analysis, and capacity planning tools for comprehensive system tuning. It is mostly geared toward mainframe applications and does not address any of USDA's criteria such as WAN network optimization.

- **Siemens AG.** — NETPLAN 2000

NETPLAN 2000 is a tool focusing on the transport layer within carrier networks. The tool is designed to execute a wide variety of tasks involved in the designing, expanding, or restructuring transport networks. This includes inter-switch trunk, add/drop multiplexer, crossconnects, and terminal multiplexers dimensioning. This tool is focused to the 'carrier' business and does not address all USDA's regional network requirements, in particular the service costs associated with connections to the carrier.

- **Systems & Networks** — BONEs

BONEs is a family of products for network design, simulation and evaluation. It provides versatile tools for LAN and WAN capacity planning, router network design and configuration, and Frame Relay planning. The BONEs family is a powerful simulation software package to evaluate performance. This product family addresses some of USDA's requirements, however, it does not support (nor plan to support) the cost optimization functionality which is one of USDA's main requirements.

- **Zitel** — Capacity Planner / NetArchitect

Zitel's Capacity Planner is designed to analyze, model and evaluate an enterprise-wide systems architecture and its various components (Central Processor Units (CPUs), Input / Output (I/O) throughput, storage, etc.). Zitel's NetArchitect is designed for the analysis and modeling of workloads distributed across an enterprise network, including hubs, routers, switches, gateways, workload specifications, etc. Using these two products, detailed reports can be generated regarding systems or network problem areas and benefits of specific configuration modifications. This tool has the capability to model network components workloads. However, it does not specifically address the network transport capacity nor service associated costs

## **2.3 SYSTEMS FOR FINAL CONSIDERATION**

This section provides an overview of the five network analysis tools that have been identified from the initial list of candidates meeting the essential USDA's criteria as specified in the *Network Modeling Tools Evaluation Criteria*. The following tools are included in the final list submitted for USDA's considerations: Bellcore's Planning Workbench Suite, GRC International's NetWork VUE, GRC International's NetSolve, Make Systems' NetMaker XA, and NAC's WinMind.

The network analysis tools submitted for USDA's considerations (presented in this section) support graphical "object" and "text" presentation of initial and optimized network configurations. Various information on the network details, such as nodes and links, are obtained through "pull-down" menus and they all support printing of graphic and text reports.

### **2.3.1 Bellcore — Planning Workbench Suite**

#### **Overview**

Bellcore has addressed the complex process of large-scale network planning with the familiar concept of Computer Aided Software Engineering (CASE) tools. The Planning Workbench is made of multiple network planning tools which have a similar Graphical User Interface (GUI) and each can be used in conjunction with the others to plan hierarchical and multiple service networks.

The current Planning Workbench's set of software tools includes Frame Relay, ATM, and SONET / Synchronous Digital Hierarchical (SDH). Network data can be interchanged among the tools to simplify multi-service network planning (e.g.: ATM over SONET physical network). All of the Planning tools can import data in a flat file format using applications such as Microsoft Excel, allowing users to specify network and service data (i.e.: tariffs and device information) using spreadsheet programs. The Frame Relay and ATM Planning tools optimize designs that offer the required switching and trunking capacity at least cost while meeting the overall performance requirement specified by the user. Release 1.3 of the Frame Relay and ATM tools, to be released at the end of March 1997, provides additional performance analysis features. All tools run stand-alone on a Sun SPARCstation. A per-user license for the CPLEX software is required. A Windows PC can be used to run the display if deployed in a client / server application.

The details of the support of the Bellcore's Planning Workbench system presented below are based on documentation and telephone conversations with the vendor. Bellcore's schedule precluded a presentation of a 'live' demonstration of Release 1.3 of the software in the time frame required to complete this document. This report section addresses the Planning Workbench, Release 1.3. USDA and PILOT participated in a demonstration of Release 1.2 in December 1996.

#### **Features**

##### **Network models supported**

The Bellcore' Planning Workbench software suite addresses Frame Relay, ATM and SONET/SDH network technologies. It does not address directly T1 and Fractional T1, but such services can be defined by the user. A software module is also available to exchange data from one member of the suite to another. This provides the capability to model hybrid networks (e.g.: modeling a Frame Relay network over an underlying ATM transport).

##### **Modeling capabilities**

The nodes used to 'build' the network model are characterized by their type (core switch, edge switch, concentrator), capacity based on throughput, cost (detailed on a per-port basis), placement, and queuing delay. Additional information about their fixed or optional location and survivability requirements can also be specified.

Physical links of various speeds needed to complete the model can be specified including 56/64 Kbit/s, T1 and Fractional T1. Link capacities of 6 Mbit/s to OC-192 are used in ATM and SONET/SDH modeling. Length and recurring and non-recurring costs are specified for each link.

While traffic flows may be defined by the user, the tool also supports a library of default traffic flows used in the modeling of logical links. As for the physical links, recurring and non-recurring costs are associated with logical links (i.e.: Permanent Virtual Circuits (PVCs)). In addition, traffic characteristics such as Frame Relay Committed Information Rate (CIR) and preferred routing may also be specified.

While the maximum model network size is dependent on factors such as the number of paths between nodes, the 500 nodes minimum requirement can be easily accommodated with this tool.

### **Modeling input data capabilities**

The initial network model is usually entered manually into the Planning Workbench tool by placing nodes and links directly onto the screen's 'canvas'. The tool supports a comprehensive set of icons to specify network elements and their attributes. Network configurations can be saved files and retrieved for later use. Currently the tool does not have the capability to interface to external tools for network discovery or traffic flow information gathering. However, this functionality is planned by Bellcore for future releases. Like the WinMIND tool, the Planning Workbench supports a library of default traffic flows based on service type (e.g.: SNA model). Additional traffic flows can be specified and added to the database by the user.

The Planning Workbench suite does not support tariff data bases nor a device library. Such databases can be created externally with spreadsheet programs such as Excel and imported to the tool using a flat-file format. Because of the lack of internal tariff database, the cost calculation of links crossing LATA boundaries (e.g.: T1 dedicated facility) may not be accurate.

### **Optimization capabilities**

The Bellcore's Planning Workbench suite is capable of optimizing a network based on cost and performance. Like WinMIND, this tool uses the performance as a constraint to optimize the cost. As the optimization proceeds, the network configuration changes accordingly. The Bellcore optimization algorithm takes into account transport rates and their fixed and per mile relative cost, existing or planned candidate sites for network nodes, traffic demands, and end-to-end survivability requirements. Bellcore provides an extensive survivability analysis using the logical path Traffic Restoration Level (TRL) attribute. For the costing of a service such as dedicated facility (e.g.: T1), the tool does not take into account crossing of LATA boundaries. Such costs need to be addressed independently by the user.

The performance analysis function of the tool provides a sensitivity analysis of network performance to increases in mean or peak transmission rates. The tool can perform failure analysis based on performance in the event that any of the nodes selected by the user fails. The Planning tool considers four perturbations in two traffic parameters — mean and peak

transmission rate — and estimates end-to-end and link-by-link performance for each disturbance for all node failure scenarios.

As the result of the optimization process, the tool provides the effective bandwidth required to meet grade-of-service criteria, direct and redundant routing for each demand and sizing and cost of any additional links or nodes that are required.

### **Reporting capabilities**

The Bellcore Planning Workbench tool presents a layout of the network model on the computer screen. Zooming-in and -out capability is also provided. While the relative positions of nodes can be displayed, no geographical maps are provided (US, States, nor LATA maps). As for other tools being considered, the Planning Workbench provides the capability to ‘click’ on a network element presented on the ‘canvas’ and a pull-down menu will presents all the information associated with that element (cost, location, throughput, etc.). Unlike WinMIND, the Bellcore tool can present upon the network graphical topology the network logical paths (e.g.: PVCs) as well as the physical paths.

All of the information presented in Windows displays can also be presented in ‘text’ formatted reports. There are summary and detailed reports presenting information related to the model network elements. The Placement Summary report provides information on the cost of the network (both equipment and transmission). The tool is capable of running “what-if” scenarios representing several network configuration alternatives and presenting results in a single report where each alternative cost and performance data are presented.

### **Ease of Use**

The Bellcore Planning Workbench suite is composed of three tools that can be purchased separately: Frame Relay, ATM and SONET/SDH. Any of the components runs stand-alone on a Sun SPARCstation. A per-user license for CPLEX (optimization software) is required. A Windows PC can be used to run the display if the system is deployed in a client/server application.

In general, this tool presents a good interactive and friendly graphical display of the network model. However, it lacks somewhat in details: no geographical mapping capability, and limited in the choice of network node and link types. The process for using the tool is generally intuitive. In addition, the tool provides parallel step-by-step procedural help that can be opened and used alongside the actual data screens. While the tool-bar icon symbols supporting the design canvas may not always be obvious, a dropped ‘balloon’ providing additional details is presented as one click on the icon.

All data presented on the screen (including graphics), in text reports, and imported data can be printed. This tool, as for the others under consideration, provides the capability to import / export information in a flat-file format.

### **Vendor Support**

In 1996, Bell Communications Research (Bellcore) introduced the ATM Planning tool as an element in a broader suite of network planning products in Bellcore's Planning Workbench. Since then, Frame Relay and SONET / SDH tools have been added to the suite. The customer base showing interest in the Planning Workbench includes carriers such as Nynex, Bell-south and Bell Atlantic and companies such as CIMI Corporation, which are using the ATM tools.

Bellcore supports their products through a maintenance contract. The contract includes consulting at no charge and software updates. Hands-on training is also available. Bellcore provides all necessary user and installation guides with the software package. The software is available on diskette or Compact Disk Read Only Memory (CD ROM). The installation can be performed by the user or Bellcore on the user provided hardware.

Release 1.3 of the Planning Workbench is to be available at the end of March 1997. Note that this section of the report is based on Release 1.3 which, among other functions, provides performance analysis capabilities which is one of USDA's requirement.

### **Associated Costs**

The cost of the Sun SPARCstation-20 (recommended by the vendor) is priced at \$15,000.

The licensing fee per copy / per user is as follows:

- 1 copy: ATM — \$125,000; Frame Relay — \$62,500
- 2 copies : ATM — \$112,500; Frame Relay — \$56,300
- 3 copies: ATM — \$112,500; Frame Relay — \$56,500
- 4 copies: ATM — \$100,000; Frame Relay — \$46,900
- 5 copies: ATM — \$100,000; Frame Relay — \$46,900

Any additional user: \$10,000

The CPLEX Optimization software is required by the tool, but is licensed separately at a cost of \$9,000. Note that only one copy of the CPLEX software is required regardless if only one tool such as Frame Relay or the whole suite is implemented. In the case where two or more tools of the suite are implemented, the Data Exchanger is used to import/export data from one tool to the other. The data exchanger is quoted at \$19,000.

There is a \$5,600 charge for Bellcore to install the software on the user-provided workstation. Training on the use of the tool is listed for \$12,000 and the maintenance contract is 25% of the license fee per year (e.g.: for one copy of the Frame Relay tool, the maintenance fee would be \$15,600).

## Scoring

The scoring of the Bellcore's Planning Workbench system presented below is based on documentation and telephone conversations with the vendor. Demonstration of Release 1.3 of the software could not be scheduled in time for this report.

Bellcore — Planning Workbench, Release 1.3			
Criteria	Max. score	Actual score	Comments
* Model supported	1.5	1.0	<u>Pro:</u> <ul style="list-style-type: none"> <li>Easy migration to ATM analysis</li> </ul> <u>Con:</u> <ul style="list-style-type: none"> <li>T1 and Fractional T1 network modeling not readily supported</li> </ul>
* Modeling Capability	2.0	1.6	<u>Pros:</u> <ul style="list-style-type: none"> <li>Model can support wide variety of link speeds</li> <li>Support of logical paths using service description, traffic flow and traffic types</li> <li>Good survivability modeling options</li> </ul> <u>Con:</u> <ul style="list-style-type: none"> <li>Limited node modeling capability</li> </ul>
* Tool input Capability	1.5	0.6	<u>Pros:</u> <ul style="list-style-type: none"> <li>Comprehensive set of icons representing network components</li> <li>Library of default traffic flow description</li> </ul> <u>Cons:</u> <ul style="list-style-type: none"> <li>No Network Management System interface support</li> <li>No integrated tariff database</li> <li>No device library support other than very generic devices</li> </ul>
* Optimization Capability	2.0	1.7	<u>Pros:</u> <ul style="list-style-type: none"> <li>Extensive survivability analysis support</li> <li>Good network model performance analysis</li> </ul> <u>Con:</u> <ul style="list-style-type: none"> <li>Accurate costing of circuit requires carefully prepared user input (no internal tariff support)</li> </ul>
* Reporting Capability	1.0	0.7	<u>Pro:</u> <ul style="list-style-type: none"> <li>All traffic type represented graphically</li> </ul> <u>Con:</u> <ul style="list-style-type: none"> <li>No geographical map (States and LATAs) in topology background</li> </ul>
*Ease of Use	0.5	0.4	<u>Pros:</u> <ul style="list-style-type: none"> <li>Network topology can be designed using PC mouse</li> <li>Comprehensive on-line real-time help</li> <li>Easy add-on ATM and SONET/SDH capability</li> </ul>
Vendor Support	1.0	0.8	<u>Pros:</u> <ul style="list-style-type: none"> <li>Consulting at no charge</li> <li>Bellcore history indicative of its commitments</li> </ul> <u>Con:</u> <ul style="list-style-type: none"> <li>Separate license required for its optimization engine</li> </ul>
Cost	0.5	0.2	<u>Cons:</u> <ul style="list-style-type: none"> <li>Appear excessive for provided functionality</li> </ul>
Total	10.0	7.0	Note: (*) indicates that the scoring is derived only from literature and conversation with the vendor.

### **2.3.2 GRC International — Network VUE**

#### **Overview**

Network VUE has its roots in Artificial Intelligence (AI) technology. The system contains an expert system for optimizing WAN networks based on cost and performance. The Network VUE Optimizer provides the capability to optimize a network configuration based on cost and performance. The Designer module allows the user to input specific information like network device configurations. This can be done manually or via the Searcher database containing a library of communication devices and WAN links. The database includes prices and detailed information from over 14 vendors such as Cascade Communications, Cisco Systems, and Newbridge Networks. Also supplied are domestic tariffs and non-tariffed rates for services from various providers such as AT&T, Cable & Wireless, LDDS, MCI and FTS2000. Network VUE's Reporter module can generate several canned reports, including geographical and logical maps and comparison graphs.

The description of the Network VUE below is based on information found in literature and conversation with the vendor. Attempts to schedule demonstration of the tool have been unsuccessful.

#### **Tool's Features**

##### **Network models supported**

Network VUE is capable of modeling Frame Relay and ATM networks. The Frame Relay performance optimization features are not yet fully implemented. However, it appears that there is enough functionality in this tool to satisfy USDA's requirements. Modeling of T1 and Fractional T1 network based on dedicated facilities is supported.

##### **Modeling capabilities**

Network VUE's Importer facility takes specific existing topology and traffic data and transforms it into the foundational database used by the tool as the basis for building the baseline network model. The Designer module lets also the user build a network model from scratch. The tool's network model building blocks are:

- Nodes including switches, router and end-points. A node is characterized by its location (V/H coordinates), installed cost, port density and speed, and survivability requirements. A node can be tagged as 'inactive' prior to run simulation or optimization.
- Physical Links including 56/64 Kbit/s, T1, Fractional T1 and T45. OC-3 modeling is not available with the tool. A link is characterized by its length, specified in 'airline miles', and service cost derived from the tariff database. A link can also be tagged 'inactive'.
- Logical links are described as traffic vectors and are characterized by the traffic speed (bits per second), packet size, and peak rate. This tool assumes the CIR of Frame Relay PVC equates to peak rate. Cost of service, derived from the tariff database, constraints such as number of hops, and performance objectives are also attributes related to the logical links.

Network VUE is capable of modeling large networks and modeling a 500 node network should not encounter any restrictions.



### **Modeling input data capabilities**

Network VUE provides the capabilities to enter network model described in a flat-file format via the Importer module. An interpreter program is required to interface with the GRC interface format. GRC has an interpreter for HP Openview used for discovery of an existing network. The tool's Designer module allows the user to build a baseline network model from scratch. Network VUE provides the capability to build the model components, including routers, switches, trunks and endpoints. Also, traffic profiles, node locations, and performance objectives or requirements are also entered.

The tool Searcher module is a database, updated on a regular basis, of major network components (device library with devices from fourteen different vendors) and service providers' tariffs, providing Network VUE with a design capability at the component level. Custom tariffs can be imported to the tool into a flat-file format. In addition, there is a Tariff Editor allowing the customization of the existing tariff. The device library cannot be edited, but users can create their own specific device libraries.

### **Optimization capabilities**

The Optimizer module using the baseline model or user-prescribed "what if" scenarios, models multiple scenarios and extracts optimal configurations based on cost and performance objectives. As for NetMaker XA, Network VUE offers a selective optimization preference (e.g.: Optimize on Delay). The Network VUE Optimizer provides three functions:

1. It determines the best optimization strategy, given a traffic profile and user's requirements, goals and preference.
2. It generates options while filtering out poor option combinations.
3. It provides qualitative and quantitative ranking on the best optimization solution.

The tool's expert system operates in an integrated fashion with the other components of Network VUE. It also derives performance data (traffic volume and delay) from a network communication simulation. The expert system uses vendor details from the device library and cost information from the tariff data base.

The tariff data base supported by Network VUE includes the required FTS2000 and LECs Frame Relay and dedicated services. As expected, the ATM tariffs are not yet available.

The Network VUE's Simulator generates traffic at each application layer, specifying any mix of traffic, protocol or loading overhead.

### **Reporting capabilities**

Network VUE presents the network model being analyzed on the computer screen. Zooming and re-sizing capabilities are supported by the tool. However, information related to the model such as node and link placement, associated costs, traffic volume and others cannot be retrieved interactively from the graphical display. The tool supports limited interactive interface capability.

Network VUE has an extensive text report capability (42 reports). The suite includes reports covering topics from geographical maps to response curves and comparative pricing graphs. The tool's Reporter module allows creation of customized reports tailored to the user's needs. Tabular reports can be exported to spreadsheet programs.

### **Ease of Use**

The Network VUE software is designed to run on Sun SPARCstation-5, -20 and Ultra. The operating system requirement is SunSolaris, version 2.4 or 2.5. The system can run as a stand alone or in a client/server environment. The software is available on CD ROM and is installed by the vendor on the user-owned hardware.

The tool provides a Windows environment. However, it does not support a good interactive interface with the user. The tool has comprehensive 'help' screens and allows real-time editing.

Network VUE support import / export of American Standard Code for Information Interchange (ASCII) comma-delimited flat files. Printing of graphical views and text reports is also supported.

### **Vendor Support**

GRC International (GRCI) has provided knowledge based-professional services for over 35 years to commercial and government clients world-wide. GRC Telecommunications group also provides network interface products for SONET networks and customized software applications for telecommunications partners.

A press release from GRCI dated February 13, 1997, states that "The company is also seeking to sell its OSU® Network Interface business, its Network VUE™ software business, and the business comprising its Advanced Products Division...". The Press Release also states that "The company reported a net loss of \$19.1 million, or \$2.05 per share, on revenues of \$30.3 million for the second quarter ended December 31, 1996".

From the information obtained from the vendor, GRC provides a maintenance contract for this tool. The tariff database is updated monthly on CD ROM and the device library is upgraded quarterly. It was also indicated that the training and documentation are part of the Network VUE package. No other details are available on the vendor's support of this tool.

### **Associated Costs**

The hardware required to support Network VUE (Sun SPARCstation-20) is quoted at \$15,000.

Other than the Network VUE license is \$75,000 and assumes a license for the Oracle Database software, no additional information is available from GRC at this time.

According to *Data Communications* magazine, March 21, 1996, Network VUE "costs between \$70,000 and \$125,000 for a single license. Additional licenses cost between \$25,000 and \$40,000. The Searcher database (tariffs) updates will cost about \$10,000 a quarter."

## Scoring

The scoring of GRC's Network VUE system presented below is based only on documentation and telephone conversation with the vendor. A "live" demonstration of this device could not be scheduled with the vendor.

GRC International — Network VUE			
Criteria	Max. score	Actual score	Comments
* Model supported	1.5	1.2	<u>Pro:</u> <ul style="list-style-type: none"> <li>Support of Frame Relay, T1, Fractional T1 and ATM network topologies</li> </ul> <u>Con:</u> <ul style="list-style-type: none"> <li>Frame Relay support not fully implemented</li> </ul>
* Modeling Capability	2.0	1.7	<u>Pro:</u> <ul style="list-style-type: none"> <li>Very versatile modeling capability</li> </ul> <u>Con:</u> <ul style="list-style-type: none"> <li>Link speeds above T1 speed not currently implemented</li> </ul>
* Tool input Capability	1.5	1.4	<u>Pros:</u> <ul style="list-style-type: none"> <li>Good importing capability, including flat-file format and Network Management system interface</li> <li>Includes tariffs and device library specified by vendors</li> </ul>
* Optimization Capability	2.0	1.9	<u>Pros:</u> <ul style="list-style-type: none"> <li>Support of "what if" scenarios</li> <li>Simulation capability</li> <li>Optimization preference selection</li> </ul>
* Reporting Capability	1.0	0.8	<u>Pro:</u> <ul style="list-style-type: none"> <li>Extensive text report capability</li> </ul> <u>Con:</u> <ul style="list-style-type: none"> <li>Cannot retrieve network component attributes from the graphical model topology</li> </ul>
* Ease of Use	0.5	0.3	<u>Pro:</u> <ul style="list-style-type: none"> <li>Comprehensive 'Help' and editing capabilities</li> </ul> <u>Cons:</u> <ul style="list-style-type: none"> <li>Requires multiple software modules</li> <li>Limited interactive user interface with graphical network topology</li> </ul>
* Vendor Support	1.0	0.2	<u>Con:</u> <ul style="list-style-type: none"> <li>Life of this product is uncertain as this part of the business is for sale.</li> </ul>
* Cost	0.5	0.3	<u>Pro:</u> <ul style="list-style-type: none"> <li>Price is in step with functionality.</li> </ul> Note: The pricing information available is derived from trade press and telephone conversation with the vendor
<b>Total</b>	<b>10.0</b>	<b>7.8</b>	Note: (*) indicates that the scoring is derived only from literature and conversation with the vendor.

### **2.3.3 GRC International — NetSolve**

#### **Overview**

NetSolve is an earlier GRC product than Network VUE. It is designed for a smaller hardware platform (e.g.: laptop). It is a Windows-based tool that was developed to provide network modeling, logical organization of model elements, and optimal networking solutions. This tool addresses meshed and hierarchical network configurations (i.e.: Frame Relay, X.25 and ATM). This suite includes a Frame Relay Pricer used in the costing and optimization of Frame Relay network configurations. The NetSolve mesh network capabilities include optimization of links utilization, traffic route optimization, network performance analysis, and optimization of the network configuration to survive switches and links failure. The Hierarchical Network Designer performs pricing, performance analysis, traffic routing, optimization of router/multiplexer placement for point-to-point and multipoint hierarchical networks (e.g.: SNA). The tool determines routing on a least-cost routing basis using leased communication facility tariff database. NetSolve provides reports in a graphical and text report format. Presentation of results includes geographical maps, brief reports (e.g.: pricing synopsis of each circuit) and detailed reports (e.g.: installation and recurring cost for each component of the network configuration).

The description of NetSolve capability is based uniquely on the NetSolve system's available documentation. As for the Network VUE tool, attempts to contact the vendor and schedule a demonstration of this tool were unsuccessful.

#### **Tool's Features**

##### **Network models supported**

NetSolve supports modeling of Frame Relay, T1, Fractional T1 and ATM mesh and hierarchical networks. Unlike Network VUE, NetSolve provides full support of Frame Relay modeling and optimization.

##### **Modeling capabilities**

A network configuration model is 'built' by using the tool's Network Designer Model module. The network components and their attributes can be specified using the Network Designer Model Windows menu. The following network components and their characteristics can be defined:

- Nodes such as multiplexers, switches and hosts can be defined. Node placement (using V/H coordinates or LATA number), port information (density and speed), survivability characteristics, and internal node delays are attributes associated with the nodes.
- Physical links such as 56/64 Kbit/s, T1 and Fractional T1 can be defined. The link length, endpoint location, and associated cost information derived from the tariffs are used to specify a link.
- Logical links are described by their message definitions and characteristics. Included are cost of service, derived from the tariffs (e.g.: Frame Relay Pricer), point-to-point location, and constraints such as the maximum number of hops.

While NetSolve is designed to support modeling of small and medium size networks, it is capable of supporting a 500-node network model.

### **Modeling input data capabilities**

One can certainly specify network configurations and associated parameters using NetSolve Windows menus. Also, files of previously saved optimized network configurations can be re-used. However, unlike the other tools under consideration, the tool does not appear to support any network configuration importing features. Node and traffic profiles are entered in the tool's Windows menus.

A tariff database is available in the NetSolve tool. No device library is supported. One would have to assume that the tool would allow the editing of the database to create custom tariffs.

### **Optimization capabilities**

NetSolve's Mesh Analyzer module calculates the node and line loading for private leased-line mesh network topologies. The primary function of the analyzer is to model traffic flow in the network model, reporting link usage and switch loading in terms of originating, terminating, transient, local and aggregate traffic using existing or defined routing.

NetSolve's Mesh Linker optimally designs links and routes traffic to satisfy specific design constraints based on user-specified switch locations and traffic flows. The tool determines the optimal interconnections between nodes. Constraints, such as number of hops and peak traffic, are accounted for in the optimization process. The tool emulates the traffic routing, determines the topology, and sizes links according to a user-specified set of link speeds and tariff combinations.

NetSolve optimally augments a network resources such that all traffic will be carried for any single or double component failure. It identifies the order of importance of network changes for reliability, for maximum cost-effectiveness.

NetSolve uses its internal tariff database for network model cost optimization. The tariff database includes FTS2000 and Local Exchange Carriers (LECs) Frame Relay and dedicated services. As with the other tools, ATM tariffs are not available.

### **Reporting capabilities**

NetSolve provides a range of graphical and text report formats. The tool supports the capability to customize geographical maps representing the topology of the network model using color codes to differentiate nodes and links. States and LATA boundaries can be specified and the tool provides zooming and re-sizing capabilities.

The tool provides details of the network topology by opening the appropriate tool's windows. The information includes nodes and links placement, sizing, recurring and non-recurring costs, capacity, and throughput.

NetSolve supports brief and detailed text format reports. The brief report presents a pricing synopsis of each circuit and a network total cost. The detailed report provides installation and

recurring costs for each components of each circuit and the information needed to place an order including Vertical / Horizontal (V/H) coordinates, CCLID codes, LATA numbers and more.

### **Ease of Use**

NetSolve tool software is designed to be implemented on an IBM PC-compatible, with a 80386 CPU or higher speed. Windows 3.11 or later version can be used as the operating system platform.

Like its successor — Network VUE, NetSolve does not provide the capability to directly interact with the graphical network model topology (click and draw) as it is supported on the Bellcore tool. The product literature, did not state whether the tool support real-time editing.

The tool can export data in a flat-file format. It also provides the capability to print any graphical views and test reports generated by the tool. Unlike the other tools under consideration, NetSolve does not appear to have any importing capability.

### **Vendor Support**

GRC International (GRCI) has provided knowledge-based professional services for over 35 years to commercial and government clients world-wide. GRC Telecommunications Group also provides network interface products for SONET networks and customized software applications for telecommunications partners. A press release from GRCI dated February 13, 1997, states that “The company is also seeking to sell its OSU® Network Interface business, its Network VUE™ software business, and the business comprising its Advanced Products Division....”. The Press Release also states that “The company reported a net loss of \$19.1 million, or \$2.05 per share, on revenues of \$30.3 million for the second quarter ended December 31, 1996”.

It is assumed here that NetSolve software would also be part of the business subjected to be sold.

No information concerning GRC’s support of NetSolve is available at this time.

### **Associated Costs**

No information concerning GRC’s licensing fees for NetSolve software is available at this time.

### **Scoring**

Attempts to contact GRC regarding current capabilities and availability of the NetSolve software tool has been unsuccessful. PILOT feels that it would not be appropriate to score this system on the limited information available.

### **2.3.4 Make Systems, Inc. — NetMaker XA**

#### **Overview**

NetMaker XA is a suite of software network decision tools that helps identify potential existing network problems, analyze the impact of network changes and expansion, and optimize cost and/or performance. Each tool of the suite can be purchased separately to fulfill specific needs. The suite consists of the following tools:

- the Visualizer — provides graphical capability for viewing, organizing, querying, and reporting on network data nodes and traffic. The Visualizer is required for implementation of all other NetMaker XA tools;
- the Interpreter — is a graphical traffic analysis tool that extends the capabilities of a traffic probe and analyzer products;
- the Accountant — is a financial modeling tool for tracking and allocating network costs. The Accountant supports plug-ins for a variety of tariff databases including US, FTS2000, and custom pricing;
- the Planner — is a device-specific simulation tool for engineering network changes. Planner addresses LAN/WAN performance and utilization;
- the Analyzer — combined with the Planner and Analyzer plug-ins, helps develop disaster-recovery plans and measure network sensitivity to changes and potential failures; and
- the Designer — is an adaptive tool for optimizing enterprise networks. It provides the capability to explore alternative network topologies to minimize cost and improve performance.

NetMaker XA is a distributed system based on a client/server architecture running under the SunOS 4.1.3, SunSolaris 1.1, or IBM AIX operating systems.

#### **Tool's Features**

##### **Network models supported**

As for all the other tools under consideration, NetMaker XA supports modeling of Frame Relay, T1, and Fractional T1. Like the WinMIND tool, the current release of NetMaker XA does not yet have ATM modeling capability. ATM support for this tool is planned for release in September 1997. In addition, NetMaker XA supports modeling of LAN sub-networks accessing the WAN.

##### **Modeling Capabilities**

NetMaker support an extensive modeling capability. In addition to the usual WAN network elements such as switch, router, concentrator, and physical / logical link supported by the other tools under consideration, NetMaker XA supports also LAN subnetworks and LAN segment objects to configure a complete LAN / WAN hybrid network configuration. A node is described by using the major attributes including placement (specified by its V/H and Longitude / Latitude coordinates), node cost, node port information (density and speed), survivability requirement and processing delay.

NetMaker XA physical link capacity modeling includes 56/64Kbit/s, T1/Fractional T1, T45, OC-3, and others. In addition, the tool provides the capability to define a “customized” physical link

model. Logical links are specified by their traffic description, traffic flow characteristics and traffic type. This includes traffic profiles based on a wide range of protocols (e.g.: IP, IPX, X-Windows, and many others). This tool supports all the attributes to specify a link (physical and logical) including length (miles or kilometers) service cost derived from the tariff, survivability requirements and constraints such as maximum number of hops.

NetMaker is designed for modeling very large networks. With the appropriate hardware platform (e.g.: Sun UltraSPARC workstation), NetMaker XA can support large network configurations (e.g.: 10,000 nodes).

### **Modeling input data capabilities**

NetMaker XA's Visualizer module allows to model a network configuration manually using its drag-and-drop object facility or by importing network configurations from previously saved optimization runs. In addition, it is capable of importing configuration generated by most popular SNMP and Network Management System (NMS) on the market today via its built-in query engine. Import of external configuration described using spreadsheet programs and saved in ASCII flat- file format is also possible.

Network traffic models used in the performance analysis process can be obtained from different sources. As for the other tools, traffic models can be created manually and saved for future use. In addition, the NetMaker XA tool's Interpreter module can retrieve traffic models from its internal traffic-type catalog, or derive them from SNMP / NMS feeds and network monitoring tools.

NetMaker XA's Visualizer provides generic node modeling capability as well as "infinite" capacity nodes. This features allows the collapse of an entire backbone network into a "switch" model with infinite capacity. Like GRC's Network VUE, NetMaker XA supports an internal network device library specified by vendors (e.g.: Wellfleet, Cisco, 3Com). Importing of a custom network device library via an ASCII flat-file format is also possible.

NetMaker XA supports a tariff database used for cost analysis and optimization purposes. If there is need for custom tariffs, they can be created by editing the internal database or they can be imported in a flat-file format. In addition, the NetMaker XA support a "generic" tariff data base for applications where detailed carrier tariffs are not required (e.g.: "ball-park" figures). The generic data base accuracy is about  $\pm 10\%$ .

### **Optimization capabilities**

NetMaker XA optimizes network configuration based on cost and performance. It provides an extensive set of optimization options not found in the other tools being evaluated. NetMaker XA, like Network VUE, allows a user selectable optimization preference: cost, performance or a mix of the two.

The NetMaker XA Designer module is responsible for the optimization of network configuration. Cost optimization is based on least-cost routing. The service costs are derived



from the tariff databases managed by NetMaker's Accountant module. The Makes-provided tariff databases including Frame Relay and dedicated services for the LECs and FTS2000 inter-LATA services. As for the other tools being reviewed, there are no ATM tariffs yet available. The NetMaker XA tool uses the cost of equipment for service implementation and total network cost calculation; only the links (physical and logical) are optimized. The tool's Designer module explores alternative network topologies to minimize recurring costs of network bandwidth, and identify potential improvements in network performance and reliability.

NetMaker as an extensive failure analysis capability. It can emulate the failure of each node, physical, and logical links and report the consequences of the failure in term of percentage of traffic being re-routed to other links.

The NetMaker XA's Planner module allows "what-if" scenarios such as adding users and applications by using pre-defined traffic flows. Planner helps to identify optimal deployment of network resources and LAN and WAN performance and utilization. Network performance analysis takes into account traffic volume, link and node sizing, and network component delays.

### **Reporting capabilities**

NetMaker XA offers an extensive graphical and text reporting capabilities. NetMaker XA's Visualizer supports comprehensive graphical features for viewing, organizing, querying and reporting network data. View and subviews of the network configuration can be presented on the screen simultaneously and each of the windows can be saved on files. The network model's map background (i.e.: US map) does not show the LATA boundaries as WinMIND system does; only States boundaries are shown. Details of node and link attributes, costs (service, device, and total costs), performance information including links and end-to-end round-trip delays, as well as comparison figures are readily available from various window screens. The versatility of the reporting capability can be overwhelming at times. The same software module also generates text reports (180 in all). All information available on the various windows can be presented in exportable text, table and spreadsheet formats.

### **Ease of Use**

Make Systems recommends the Sun SPARCstation-20, or UltraSPARC as hardware platform to provide an efficient and effective utilization of the NetMaker XA tool's modules.

NetMaker XA provides a very comprehensive and detailed Windows environment to design and analyze very large and complex networks. The recommended hardware platform allows multiple users to share the tool resources. As for the other considered tools, NetMaker XA supports real-time editing capability of all the network model attributes.

NetMaker XA provides extensive capabilities for importing, exporting and printing of network configurations, results of network analysis (cost and performance) and optimization results.

The tool software provide various help facilities, including the documentation on-line. A hard-copy of the tool documentation (3 books) is provided with the purchase of the software.

## **Vendor Support**

Make Systems, founded in 1986, is a provider of software-based solutions that improve the efficiency and effectiveness of enterprise networks. Products include NetMaker XA suite of network decision tools and NetMakerSolutions consulting services. Field offices are located throughout the U.S. and Western Europe; qualified resellers and systems integrators as well as the direct sales staff market products and services worldwide. The company has customers worldwide including Fortune 500, government, and carrier organizations. It is privately owned and employs about 65 peoples.

Make Systems offers a maintenance service contract with the purchase of the NetMaker XA software packages. The maintenance program includes the tool's software updates, tariff updates (every 90 days), device library updates, and initial system installation. The contract also includes phone consultation using an 800 number. Additional support such as training, in-person consultation is also offered by Make Systems.

NetMaker XA, Release 2.6 is available now. Release 2.7 with performance and Frame Relay additional functionality will be available by the end of the 1st quarter of 1997 and Release 3.0 supporting ATM and Virtual LAN (VLAN), will be available by the third quarter of 1997. All new releases are covered under the maintenance contract.

To be noted that among NetMaker's six different modules, which can be acquired separately, the Visualizer is required for implementation of all other NetMaker modules. Makes recommends that all modules be procured to provide the network analysis and optimization versatility required by USDA. The software modules and their associated "plug-ins" proposed to satisfy USDA's requirements are listed below:

- Visualizer module with SNMP Discovery Agent and Enhanced Layouts plug-ins
- Interpreter module with the Probe Interface Library plug-in
- Accountant module with FTS2000 Tariff plug-in
- Planner module with Router Device Library plug-in
- Analyzer module with Router Survivability plug-in
- Designer module with Router Primitives plug-in

All user documentation related to NetMaker XA is provided with the software.

## **Associated Costs**

Make Systems recommends installing NetMaker XA software on a Sun SPARCstation-20 quoted at \$15,000.

The software cost is based on the tool's software modules and associated plug-ins proposed to meet USDA's requirements (see 'Tool Ease of Use' section above). The license fees are as follows:

- 1 copy: \$96,540
- 2 to 5 copies: \$67,529 per copy
- 6 copies: \$48,235 per copy

A cost of 10% of the cost is added for up to 4 users.

The maintenance contract is free for the first 3 months and 15% of the total license fee per year; it includes tool software upgrades and device library updates. The initial installation of the software on the user owned hardware with five days of training is priced at \$8,750. Make Systems' consulting fee is quoted at \$1,700 a day plus travel and expenses. Additional training is available at the consulting rate (\$1,700/day).

The cost of the tariff updates is \$9,995 per year. Tariff updates are available every 90 days.

## Scoring

Make Systems — NetMaker XA, Release 2.6			
Criteria	Max. score	Actual score	Comments
<b>Model supported</b>	1.5	<b>1.4</b>	<u>Pros:</u> <ul style="list-style-type: none"> <li>• Migration plan toward ATM</li> <li>• Support of LAN subnets</li> </ul> <u>Con:</u> <ul style="list-style-type: none"> <li>• No ATM support until September 1997</li> </ul>
<b>Modeling Capability</b>	2.0	<b>2.0</b>	<u>Pros:</u> <ul style="list-style-type: none"> <li>• LAN subnet modeling capability</li> <li>• Large network modeling capability</li> <li>• Extensive modeling options</li> </ul>
<b>Tool input Capability</b>	1.5	<b>1.5</b>	<u>Pros:</u> <ul style="list-style-type: none"> <li>• Capability to import network models from discovery Network Management systems and capability to import flat files</li> <li>• Integrated tariffs and device library</li> </ul>
<b>Optimization Capability</b>	2.0	<b>1.9</b>	<u>Pros:</u> <ul style="list-style-type: none"> <li>• Wide variety of optimization features</li> <li>• Comprehensive LAN WAN performance and utilization analysis.</li> <li>• Detailed failure analysis</li> </ul>
<b>Reporting Capability</b>	1.0	<b>0.9</b>	<u>Pros:</u> <ul style="list-style-type: none"> <li>• Simultaneous results display of graphics and text</li> <li>• Comparison figures (cost and performance) from one optimization 'run' to the next.</li> </ul>
<b>Ease of Use</b>	0.5	<b>0.4</b>	<u>Pros:</u> <ul style="list-style-type: none"> <li>• Multi-user capability</li> <li>• Extensive graphic facility</li> </ul> <u>Con:</u> <ul style="list-style-type: none"> <li>• Installation requires loading of six different modules</li> </ul>
<b>Vendor Support</b>	1.0	<b>0.8</b>	<u>Pros:</u> <ul style="list-style-type: none"> <li>• Vendor migration plan toward ATM and Virtual LAN (VLAN) modeling</li> </ul>
<b>Cost</b>	0.5	<b>0.3</b>	<u>Con:</u> <ul style="list-style-type: none"> <li>• Costly system</li> </ul>
<b>Total</b>	10.0	<b>9.2</b>	

### **2.3.5 Network Analysis Center (NAC), Inc. — WinMIND**

#### **Overview**

WinMIND is a Windows-based fully integrated modeling, pricing and performance analysis software tool. The tool enables designing networks that have a mix of equipment, line speeds, service protocols, and carrier inter- and intra-LATA circuits. NAC has a tariff library supports over 1,700 US tariffs, including FTS2000, and has a technical staff dedicated to maintaining its accuracy. WinMIND also determines circuit utilization and response times using defined network traffic characteristics and volumes and determines network reliability through network failure analysis. Additional network performance analysis can be performed by submitting the (optimized) topology to CACI's Comnet III simulation tool. Comnet III is capable of providing detailed information on node utilization, message delays and congestion points. It can also answer questions about performance of the current network topology based on historical or projected traffic loads. However, Comnet III does not provide any optimization or pricing functionality. The WinMIND and Comnet III software packages can coexist on a single hardware platform.

#### **Tool's Features**

##### **Network models supported**

WinMIND tool supports Frame Relay, T1 and Fractional T1 network modeling capabilities. The company is currently working to add ATM in future releases of the tool's software.

##### **Modeling capabilities**

WinMIND can analyze and optimize network configurations including nodes and links from external sources such as files in a flat-file format (e.g.: spreadsheets) or Network Management tool outputs. The models can also be specified using the tool's Windows based menus. As for the other systems proposed, nodes such as switches, routers, concentrators, end-points and links can be distinctively represented and specified using their associated characteristics: geographical placement, cost, node's port information and processing delay.

Physical link speeds of 56/64 Kbit/s and Fractional T1 and T1 can be modeled in the WinMIND. Support for higher speeds such as T45 and OC-3 is yet to be provided. Logical links, as Frame Relay PVCs, can be described by their traffic flow characteristics, including source and destination location, CIR, and peak rate. The links' associated cost information is automatically derived from the internal tariff database.

The maximum network model size is well in excess of the 500 nodes minimum criteria.

##### **Modeling input data capabilities**

Initial network configuration and traffic models can be entered in the WinMIND in different ways:

a) manually using the multiple Windows menus from which network components such as node types, links, and traffic models can be described in detail; b) using spreadsheet programs such as Excel to describe the network configuration and saved in a flat-file format that can be imported to the tool; and c) importing network information gathered from Network Management tools

(i.e. HP Openview) or other tools such as CACI' Comnet III using NAC's Network Importer software interface. Network models can also be exported to other tools like Comnet III for more detailed simulation and performance analysis.

The WinMIND system supports an integrated tariff data base. However, unlike the Network VUE and NetMaker XA, this tool does not support a network device library (e.g.: router specified by device name). Device characteristics (cost, port density and speed) must be entered manually through the Windows menus presented on the screen or via prepared spreadsheet saved as flat-files. NAC does not allow export of the carrier's tariff databases. However, editing of the internal database by the user is permitted

### **Optimization capabilities**

WinMIND optimizes a network configuration from the cost and performance points of view. The cost optimization of the network is based on a performance requirement specified by the user as a constraint.

The service cost optimization process uses the integrated tariff database, which includes Frame Relay and dedicated services for FTS2000 and local exchange carriers. The performance evaluation is based on traffic volume, link / node sizing and network component delays. As for all the other candidate tools, optimization of nodes (e.g.: cost and performance) is derived from the resulting traffic optimization process such as throughput and the number of connection required by the node.

WinMIND has a comprehensive failure analysis capability. By simulating failure of nodes and/or links, the tool figures the percentage of traffic that each network link is capable of supporting as the result of the failure. By increasing the node and link capacity, the user can model the corrective actions and observe the cost and re-routing impacts.

### **Reporting capabilities**

WinMIND tool presents a geographical view of the network topology on the computer screen. The topology can be presented covering the entire country, State and LATA boundaries can be shown. Zooming and re-sizing capabilities for a given location are supported. The user can 'click' on a link or node to obtain a pull-down menu revealing details associated with the selected network element. A copious set of menus presents the user with the details of the network model including costs, location, sizing, and performance information. Unlike the NetMaker XA and Bellcore systems, WinMIND does not show the logical path such as Permanent Virtual Circuits. However, logical path data is available from the tool's menus. As for its Bellcore and GRC solutions counterparts, WinMIND does not provide comparative figures on cost and performance from one optimization run or baseline to the next. This comparison calculation is left to the user discretion by using the results of each optimization run. But the network total cost is readily available.

WinMIND also provides various 'text' reports resulting from network modeling, evaluation and optimization. Included are reports detailing circuit configuration (link flow and traffic routing)

with itemized recurring and non-recurring charges, tariff selected, node locations, and other related information. Also included are reporting of performance details such as mean response time and data utilization for each circuit. WinMIND allows customization of reports using its Report Writer facility.

### **Ease of Use**

The WinMIND software tool is available on CD ROM and can be installed by the user in a stand-alone or LAN configurations. The supporting hardware need to be an IBM compatible PC with Windows 95 (recommended), Windows NT or Windows 3.11. The WinMIND software is loaded as a single package; not separate modules as for Make Systems' NetMaker XA and GRC systems.

As for the other candidates, the NAC product supports a graphical Windows environment for displaying the network model. However, capability for the user to interact with the geographical network topology is limited. As an example, the user cannot create a link between two nodes using the computer mouse; links need to be specified in the appropriate menu.

WinMIND makes extensive use of Windows menus to input data and retrieve analysis and optimization results. All information, including graphical displays and text reports can be printed for further examination.

Importing and exporting data using flat-file format is straightforward. NAC claims that interfacing with the Comnet III simulation tool does not present any difficulty. Data to and from the WinMIND tool are transferred in a compatible file format — C3E. Importing data from Network Management feeds requires the Network Importer software which is not included in the WinMIND software package.

### **Vendor Support**

NAC was founded in 1968, and since has been in the business of planning, design and monitoring of telecommunication networks. Initially, NAC provided consulting services to assist, trained and full time support to the client. To facilitate this support, NAC started to develop interactive network design tools. After few changes of hands, the company is now employee-owned as of three years ago and has a staff of 17. The company's 1996 revenue was about \$2 million. NAC's client base includes telecommunications companies such as AT&T Bell Labs, Newbridge Networks corporation, Southwestern Bell and GTE. It also includes companies with extensive networking needs: Commercial Union Insurance, Nations Bank and Amoco Corporation.

NAC supports WinMIND through a maintenance contract. The maintenance contract includes the tool software upgrades, tariff database updates and analyst phone consulting support. The tariffs are updated daily and can be downloaded every two weeks from NAC's web site. The CD ROM version of the tariffs is available quarterly. Training on the use of WinMIND is also available.

While NAC provides interface compatibility between the WinMIND and Comnet III (also planned to interface with Mil-3 Planner tool), NAC does not, nor plans to, support the CACI and Mil-3 products. Plans by the user to acquire the different products to be used in concert with WinMIND would require separate licensing and maintenance contracts.

Release 4.8 of WinMIND is currently available. Release 4.9, to be release by the end of March 1997, providing mostly graphical display enhancements. Tool release supporting ATM functionality including Quality of Service (QoS) is planned for January 1998.

### **Associated Costs**

The hardware cost is based on an IBM compatible PC with Pentium processor: \$3,000.

The NAC WinMIND software licensing is priced as follow:

- Copies 1 to 3: \$41,000 for PC and \$102,.000 for LAN per copy
- Copies 4 to 6: \$32,800 for PC and \$81,000 for LAN per copy

The Network Importer software needed to import data from Network Management feeds:  
\$10,000

The Maintenance contract is free for the first year and \$7,600 for PC and \$12,500 for LAN for the following years. The maintenance includes software and tariffs updates at no charge. It also includes training at no cost.

NAC provides consulting service at \$100 to \$175 an hour depending on the qualification of the consultant.



## Scoring

NAC — WinMIND, Release 4.8			
Criteria	Max. score	Actual score	Comments
<b>Model supported</b>	1.5	<b>1.2</b>	<u>Pro:</u> <ul style="list-style-type: none"> <li>• ATM migration planned for 1Q98</li> </ul> <u>Con:</u> <ul style="list-style-type: none"> <li>• No ATM modeling support until January 1998</li> </ul>
<b>Modeling Capability</b>	2.0	<b>1.6</b>	<u>Pro:</u> <ul style="list-style-type: none"> <li>• Capability to detail Frame Relay traffic flows</li> </ul> <u>Cons:</u> <ul style="list-style-type: none"> <li>• Limited set of attribute described logical links (i.e.: limited set of protocols)</li> <li>• Modeling of relatively small network (few hundred nodes)</li> </ul>
<b>Tool input Capability</b>	1.5	<b>1.3</b>	<u>Pros:</u> <ul style="list-style-type: none"> <li>• Capability to interface with Network simulator like CACI's Comnet III tool</li> <li>• Integrated tariff database</li> </ul> <u>Con:</u> <ul style="list-style-type: none"> <li>• No device library supported</li> </ul>
<b>Optimization Capability</b>	2.0	<b>1.7</b>	<u>Pros:</u> <ul style="list-style-type: none"> <li>• Good failure analysis support</li> <li>• Capability to interface with simulation tools</li> </ul> <u>Con:</u> <ul style="list-style-type: none"> <li>• May prove to be slow on large network modeling due to the PC base hardware platform</li> </ul>
<b>Reporting Capability</b>	1.0	<b>0.8</b>	<u>Pros:</u> <ul style="list-style-type: none"> <li>• Graphic support for States and LATAs</li> <li>• Extensive network model attributes presentation</li> </ul> <u>Cons:</u> <ul style="list-style-type: none"> <li>• Does not present graphically logical paths</li> <li>• No comparison from one run to the next</li> </ul>
<b>Ease of Use</b>	0.5	<b>0.4</b>	<u>Pros:</u> <ul style="list-style-type: none"> <li>• Single software package simplify installation</li> <li>• Network modeling flexibility</li> <li>• Good importing and exporting capabilities</li> </ul> <u>Cons:</u> <ul style="list-style-type: none"> <li>• Small hardware platform may limit expansion in the future</li> <li>• Limited interactive user interface with graphical network topology</li> </ul>
<b>Vendor Support</b>	1.0	<b>0.8</b>	<u>Pro:</u> <ul style="list-style-type: none"> <li>• Two new releases already planned including ATM</li> </ul> <u>Con:</u> <ul style="list-style-type: none"> <li>• Small company's staffing: 17 peoples</li> </ul>
<b>Cost</b>	0.5	<b>0.4</b>	<u>Pro:</u> <ul style="list-style-type: none"> <li>• Reasonably priced for the capability of the tool</li> </ul>
<b>Total</b>	10.0	<b>8.2</b>	

### 3. COMPARISON TABLES

#### 3.1 Scoring Comparison

	Weight / Score	Bellcore	GRC	Make	NAC
<b><u>Features</u></b>					
<b>Network models supported</b>	15% / <b>1.5</b>	<b>1.0</b>	<b>1.2</b>	<b>1.4</b>	<b>1.2</b>
<b>Modeling capability</b>	20% / <b>2.0</b>	<b>1.6</b>	<b>1.7</b>	<b>2.0</b>	<b>1.6</b>
<b>Modeling input data capability</b>	15% / <b>1.5</b>	<b>0.6</b>	<b>1.4</b>	<b>1.5</b>	<b>1.3</b>
<b>Optimization capability</b>	20% / <b>2.0</b>	<b>1.7</b>	<b>1.9</b>	<b>1.9</b>	<b>1.7</b>
<b>Reporting Capability</b>	10% / <b>1.0</b>	<b>0.7</b>	<b>0.8</b>	<b>0.9</b>	<b>0.8</b>
<b><u>Ease of use</u></b>	5% / <b>0.5</b>	<b>0.4</b>	<b>0.3</b>	<b>0.4</b>	<b>0.4</b>
<b><u>Vendor support</u></b>	10% / <b>1.0</b>	<b>0.8</b>	<b>0.2</b>	<b>0.8</b>	<b>0.8</b>
<b><u>Costs</u></b>	5% / <b>0.5</b>	<b>0.2</b>	<b>0.3</b>	<b>0.3</b>	<b>0.4</b>
<b><u>Final Score</u></b>	100% / <b>10.0</b>	<b>7.0</b>	<b>7.8</b>	<b>9.2</b>	<b>8.2</b>

### 3.2 Systems Cost Comparison

Vendors	Bellcore		NAC		Make	GRC
Model	Planning Workbench ATM	FR	WinMIND		NetMaker XA	Network VUE
Hardware:						
SPARC - 20	\$15,000	\$15,000	N/A	N/A	\$15,000	\$15,000
PC Pentium	N/A	N/A	\$3,000	\$3,000	N/A	N/A
License per Copy			PC	LAN		(note 1)
Copy 1	\$125,000	\$62,500	\$41,000	\$102,000	\$96,470	\$75,000
Copy 2	\$112,500	\$56,300	\$41,000	\$102,000	\$67,529	Not Avail.
Copy 3	\$112,500	\$56,300	\$41,000	\$102,000	\$67,529	Not Avail.
Copy 4	\$100,000	\$46,900	\$32,800	\$81,600	\$67,529	Not Avail.
Copy 5	\$100,000	\$46,900	\$32,800	\$81,600	\$67,529	Not Avail.
Copy 6	\$100,000	\$46,900	\$32,800	\$81,600	\$48,235	Not Avail.
Additional user	\$10,000	\$10,000	N/A	N/A	10% up to 4 users (note 2)	Not Avail.
Additional software						
CPLEX	None	\$9,000	N/A	N/A	N/A	N/A
Interface	None	\$19,000 (note 3)	\$10,000	\$10,000	N/A	Not Avail.
Tariff updates	N/A	N/A	No Charge	No Charge	\$9,995 per year	\$10,000 a quarter
Installation	\$5,600	\$5,600	User	User	8,750 (note 5)	User
Training	\$12,000	\$12,000	No Charge	No Charge	3-5 days Consult.	No Charge
Consulting	No Charge	No Charge	\$100 - \$175 / hr	\$100 - \$175 / hr	\$1,750 / day plus T&E	Not Avail.
Maintenance contract	\$31,300 / yr.	\$15,600 / yr.	\$7,600 (note 4)	\$12,500 (note 4)	15% of basic license	Not Avail.

Note 1: Additional ORACLE license required; license fee not available

Note 2: The additional user fee is per copy and no simultaneous use of each software modules

Note 3: Only one copy of CPLEX software is required per system; the Interface (Data Exchanger) software is required when more than one tool (e.g.: Frame Relay and ATM) are loaded on the same system. Only one copy of this software required per system.

Note 4: The NAC maintenance charge is \$5000/yr. for 4 to 10 PCs and \$9000/yr. for 2 to 5 LAN systems

Note 5: Initial installation includes 5 days of training by Make Systems

#### 4. RECOMMENDATIONS

As shown in the evaluation matrix, *Scoring Comparison*, Make's NetMaker XA leads the product ranking in most of the evaluation categories. A significant drawback, however is NetMaker's high cost as compared to the second-ranked product, NAC's WinMIND system. NetMaker's cost, including single license, hardware, one year maintenance, and tariff updates runs around \$138,000 compared to WinMIND's \$58,600.

The NetMaker system is technically superior to WinMIND in several areas:

- In addition to the capability to model Frame Relay, T1, and Fractional T1 based networks, NetMaker also has the capability to model hybrid network configurations including WAN and LAN subnetworks.
- Given the appropriate hardware (e.g.: Sun UltraSPARC), the tool can support very large network optimization within a relatively short time.
- NetMaker supports several databases including a) tariff database for LECs and Inter Exchange Carriers, including FTS2000; b) a default set of tariffs when only approximate costing is required; c) a set of pre-defined traffic flow models (e.g.: SNA and TCP/IP); and d) a library of devices that can be selected by vendors (e.g.: Cisco, Wellfleet, 3Com routers).
- NetMaker XA provides the user with a large set of cost and performance optimization options.
- The tool has extensive import and export capabilities, specially in the support of discovery of existing networks to obtain network configuration and traffic flows.

The NAC's WinMIND has certainly the capabilities required by the USDA to evaluate alternative configurations for regional networks based on cost-effectiveness and technical performance. The tool is lacking some of the 'nice' features found in NetMaker.

- WinMIND supports Frame Relay, T1, Fractional T1 and the company has planned to add ATM in the future, but does not readily support LAN subnetwork modeling.
- WinMIND has the capability to interface with network simulation tools such as CACI's Comnet III to provide additional simulation and performance analysis. This feature is not found in NetMaker.
- This tool requires additional manual data input to create the traffic flow models and device libraries, which it does not provide.
- With the recommended hardware (PC Pentium / Windows 95), WinMIND certainly can model a network size compatible with USDA's needs. However, the execution speed of an optimization run will be slower than its counterparts running on Sun SPARC workstation. As a point of reference, according to the vendor, a network topology of 1,000 access nodes, 20 switching nodes (nodes making routing decisions), and assuming a Pentium 133 Mhz with 16 Mbit of RAM, an optimization run of such network model may take as much as 1/2 hour.

While NetMaker XA is the technical leader in PILOT's evaluation and provides more than enough functionality to satisfy USDA's requirements, WinMIND supports the necessary

capability to support the USDA network modeling requirements. Therefore, given the price differential between the two leading products, PILOT presents two alternative recommendations:

1. If sufficient funds are available, acquire NetMaker XA for its technical superiority and growth potential, or
2. if USDA's budget is limited, acquire WinMIND, which still meets USDA requirements, is much less expensive, and can accommodate networks of the size USDA is contemplating (i.e.: few hundred nodes at most) on a Pentium PC platform.

## **GLOSSARY**

AI	Artificial Intelligence
ASCII	American Standard Code for Information Interchange
ATM	Asynchronous Transfer Mode — A cell switching technique using the cell relay method of transmission.
CASE	Computer Aided Software Engineering
CD ROM	Compact Disk Read Only Memory
CIR	Committed Information Rate
CPU	Central Processing Unit — Computer circuitry controlling the interpretation and execution of instructions.
GUI	Graphical User Interface
I/O	Input / Output
IP	Internet Protocol — The Network Layer protocol of the Transmission Control Protocol/Internet Protocol (TCP/IP) suite of protocols.
IS	Information Systems
LAN	Local Area Network
LATA	Local Area and Transport Area — Geographic regions within the USA that define areas within which the Bell Operating Companies can offer exchange and exchange access services.
LEC	Local Exchange Carrier
MAN	Metropolitan Area Network
MAC	Media Access Control — The method that enables network stations to access network media and transmit information.
MIB	Management Information Base — A conceptual composite of information about all managed objects in an open system.

NMS	Network Management System
PC	Personal Computer
PVC	Permanent Virtual Circuit
RMON	Remote Monitoring
SDH	Synchronous Digital Hierarchy — European standard for high-speed digital transmission; equivalent to SONET standard in the US
SNA	System Network Architecture — A seven-layer network architecture developed by IBM.
SNMP	Simple Network Management Protocol — A protocol recommended by IETF for managing TCP/IP networks, internetworked LANs and packet switched networks.
SONET	Synchronous Optical Network — A North American carrier standard developed by Bellcore that works within the digital hierarchy. This service is offered in basic building blocks of 50 Mbit/s.
TRL	Traffic Restoration Level
V/H	Vertical and Horizontal coordinates
VLAN	Virtual Local Area Network
WAN	Wide Area Network

## APPENDIX

### NETWORK MODELING TOOLS EVALUATION CRITERIA

#### A.1 Introduction

The USDA Telecommunication Services Division (TSD) needs the capability to evaluate alternative configurations for regional networks to access the FTS2000 long distance network. This requirement is especially critical for high speed data networks, such as frame relay, fractional T1 and Asynchronous Transfer Mode (ATM), whose use is growing rapidly within USDA. TSD believes there is considerable opportunity for cost savings by implementing properly designed regional data networks. TSD, therefore, requires a software tool for determining least-cost routing for a regional network. The tool must be capable of optimizing routing in both inter- and intra-LATA networks. The optimization must be based on traffic volumes and volume- and distance-dependent costs, subject to *a priori* performance and engineering constraints.

Pilot Research Associates, Inc. (PILOT) is tasked with assessing the capabilities of commercially available telecommunications network design tools. The assessment will address the tools' ability to satisfy USDA's telecommunications network requirements, including logical / physical network topology, traffic routing, node placement, node and line sizing, costs, survivability, and performance.

As part of this task, PILOT proposes a set of evaluation criteria, described in this document, to be used for comparative assessment of commercially available network modeling tools. The proposed assessment methodology is also briefly described in this document.

#### A.2 Evaluation Criteria

The criteria consist of four categories:

- *Tool Features* — functions that modeling network tools should support to satisfy the USDA's telecommunications requirements
- *Tool Ease of Use* — Tool ability to provide a user-friendly environment
- *Vendor Support* — Services and capabilities that a network modeling tool vendor should provide to support the user of the tool
- *Cost* — Fixed and recurring costs associated with the tool; costs of optional services and functions should be identified

PILOT proposes to assign each criterion an attribute reflecting its urgency of need. The proposed attributes are:

- *Mandatory* — those criteria which must be included for a modeling network tool to be considered.
- *Important* — those which should be met by a modeling network tool, but are not so critical that their absence precludes their consideration.



- *Optional* — requirements that are secondary in importance but would be nice to have.

### A.2.1 Features

#### Network Types Supported by the Tool

Capability of the tool to model and optimize one or more, or a combination of the following networking technologies:

- Frame Relay - Permanent Virtual Circuit (PVC) — **Mandatory**
- Fractional T1 / T1 — **Mandatory**
- Migration capability to Asynchronous Transfer Mode (ATM) — **Important**
- ATM — **Optional**
- 

#### Network Modeling Capability of the Tool

This section addresses criteria associated with capabilities to model networks using the following networking elements:

#### Nodes

Capability of the tool to support the following node types:

- Switch including core and edge switches — **Mandatory**
- Router — **Mandatory**
- User end-point — **Mandatory**
- Concentrator — **Important**

Modeling capability to take into account the following node related characteristics:

- Placement (Address, Vertical / Horizontal and Longitude / Latitude coordinates) — **Mandatory**
- Installed cost (one-time and recurring costs) — **Mandatory**
- Wide Area Network (WAN) port characteristics (density and access rate) - **Mandatory**
- Survivability — **Mandatory**
- Node modeling status (existing, planned, or optional) — **Important**
- Processing Delay — **Optional**

## Physical Links

Capability of the tool to support the following physical link types:

- 56/64 Kbit/s — **Mandatory**
- Fractional T1 — **Mandatory**
- T1 — **Mandatory**
- T45 — **Optional**
- OC-3 — **Optional**

Modeling capability to take into account the following physical link related characteristics:

- Length of the link — **Mandatory**
- Cost associated with physical links (port and access charges — one-time and recurring costs) — **Mandatory**
- Physical link modeling status (existing, planned, or optional) — **Important**

## Logical Links

Capability of the tool to support traffic models based on:

- Service Description (Frame Relay's Committed Information Rate (CIR), ATM's Constant Bit Rate (CBR), Variable Bit Rate (VBR), Unspecified Bit Rate (UBR)) — **Mandatory**
- Traffic flow Description (in terms of performance: peak rate, mean rate, burst length, number of sessions, acceptable end-to-end delay) — **Mandatory**
- Traffic Type (Frame Relay, ATM, Local Area Network (LAN), Applications) — **Important**

Modeling capability to take into account logical link related characteristics:

- Placement between end-points — **Mandatory**
- Cost of the service (PVC charges - one-time and recurring costs) — **Mandatory**
- Survivability requirement (Traffic Restoration Level (TRL)) — **Mandatory**
- Constraints (maximum end-to-end delay, maximum hop count) — **Important**

## Network Size

Capability of the tool to model and optimize a relevant network size:

- Minimum 500 nodes — **Mandatory**

## Tool Modeling Input Data Capabilities

This section addresses criteria related to tool input information required for modeling and optimization:

## Network Configurations

Capability of the tool to accept network configuration from:

- User configured (e.g.: Graphic User Interface (GUI), drag-and-drop network 'objects') — **Mandatory**
- Existing network configuration files (e.g.: previous tool output) — **Important**

## **Network Traffic Models**

Capability of the tool to utilize traffic models generated from:

- User configured (e.g.: text, GUI, menus) — **Mandatory**
- Existing traffic model (e.g.: previous tool output) — **Important**
- Network Management feeds (e.g.: existing USDA files) — **Important**

## **Node Profiles**

Capability of the tool to utilize nodes definitions from:

- User created — **Mandatory**
- Tool internal library — **Important**
- External data base — **Optional**

## **Tariff Information**

Capability of the tool to create service cost profile based on tariff:

- FTS2000 tariffs — **Mandatory**
- Local Exchange Companies (LEC) and Regional Bell Operating Companies (RBOC) tariffs — **Mandatory**

Capability of the tool to use tariffs from:

- User generated input — **Mandatory**
- Tool internal data base — **Important**
- USDA tariff data base — **Important**

## **Input Error Detection**

Capability of the tool to detect inconsistencies in the input data from:

- User generated entries — **Important**
- Real-time editing — **Important**
- External entries (e.g.: data base files) — **Optional**

## **Tool Optimization Capability**

This section addresses criteria associated with the tool's capability to perform optimization of a modeled network based on cost and performance.

- Tool cost optimization capability — **Mandatory**
- Tool performance optimization capability — **Mandatory**
- Automatic network reconfiguration — **Mandatory**
- Capability to select optimization preference (cost or performance) — **Important**
- Capability of the tool to base-line (cost and performance) initial network configuration — **Important**

## **Optimization Based on Cost**

Capability of the tool to calculate network cost and optimize the network based on:

- Equipment cost (initial and support) — **Important**
- Tariffs to calculate least-cost routing — **Mandatory**

Capability of the tool to use the following tariffs:

- FTS2000 Enhanced Packet Switched Service I (EPSS I) - Frame Relay (per service type) — **Mandatory**
- FTS2000 dedicated facility service — **Mandatory**
- LECs dedicated facility service — **Mandatory**
- LECs Frame Relay (per service type) — **Important**
- LECs ATM (per service type) — **Optional**
- FTS2000 Enhanced Packet Switched Service II (EPSS II) - ATM (per service type) — **Optional**

### **Optimization Based on Performance**

Capability of the tool to calculate network performance and optimize the network based on:

- Traffic volume (extracted from traffic models) — **Mandatory**
- Line and node sizing — **Mandatory**
- Survivability requirements — **Mandatory**
- Network component delays — **Optional**

### **Tool Reporting Capability**

This section addresses the criteria of the tool's ability to issue network analysis reports.

### **Graphical Views**

Capability of the tool to generate network analysis results graphically:

- Entire / selected portion of the network configuration (initial and optimized) — **Important**
- Node placement, type, size and cost — **Important**
- Optimized routing including type, capacity, back-up status and cost — **Important**
- Comparative cost and performance figures — **Important**

### **File Type Report**

Capability of the tool to generate a file (e.g.: text file) for later formatting and printing or to be used in the network analysis process.

- Optimized network detailed description in report form (e.g.: spreadsheet) — **Mandatory**
- Circuit configuration cost figures (recurring and non-recurring charges) — **Mandatory**
- Total network cost figures (equipment and services) — **Mandatory**
- Network configuration performance figures (response time, utilization, throughput) — **Mandatory**
- Comparative cost and performance figures in a file type report — **Important**

### A.2.2 Tool Ease of Use

This section addresses the tool's capability to provide a user friendly interface.

Multi-user capability:

- LAN Connectivity — **Optional**
- Client / Server application — **Optional**

Capability of the tool to provide user real-time 'friendly' interface

- 'Window-based' interface — **Important**
- Network configuration using click-and-drag — **Important**
- Real-time editing of network configuration elements (e.g.: text, GUI, menus) — **Important**
- 'Help' support — **Important**

Capability to accept input data files (e.g.: USDA Data Base files)

- Excel spread sheet — **Important**
- Comma Delimited ASCII files — **Important**

Capability of the tool to automatically optimize network configuration with minimum user inputs:

- Specify only major nodes and services — **Important**

Capability of the tool to provide 'report' facility:

- Printing of graphics and/or text reports — **Mandatory**
- Import / export standard spreadsheet and data base format — **Important**
- Ad-hoc report editing (customize) capability — **Optional**

Ease of installation of the tool's software

- User installed — **Important**
- Well documented installation procedures — **Important**
- Capability to re-install software package — **Important**
- Vendor installed — **Optional**

### A.2.3 Vendor Support

This section addresses the criteria of support of the tool vendors for their product.

Capability of the vendor to provide multiple choices of software licensing agreements:

- Multi-user licensing — **Important**
- Single-user licensing — **Optional**

Capability of the vendor to provide guidance in the use and maintenance of the tool:

- Technical support during normal business hours — **Mandatory**
- Vendor training course availability — **Important**
- Detailed documentation on software and hardware — **Important**

Capability of the vendor to provide software upgrades in a timely manner:

- Tariff data bases (if applicable) — **Mandatory**
- New releases of the tool's software package(s) — **Mandatory**
- Network device libraries (if applicable) — **Important**
- New tool functionality software upgrade(s) — **Optional**

Reliability of the vendor as to:

- Financial stability of the company — **Important**
- Length of time in the network analysis tool business — **Important**
- Long term prospect of the current product line — **Important**

#### **A.2.4 Cost**

The cost criteria is proposed as **Optional**

### **A.3 Proposed Network Tools Assessment Strategy**

The comparative assessment of network modeling tools that will satisfy USDA's requirements will be based on the criteria described in the previous section. PILOT has identified the commercially available network development tools and acquired information for their comparative assessment.

The initial identification of tools and vendors was made simply on the availability of a product capable of analyzing Wide Area Networks (WAN) configurations in some manner. This has helped prevent the premature rejection of possible candidates.

The reduction of this list to a manageable number for closer scrutiny will be based on the support or lack thereof for the essential criteria — the mandatory items, such as optimization capability based on cost and performance.

The tools that remain will be reviewed and then ranked based on the criteria defined here. Pilot proposes to use a "scoring" system in this ranking. The criteria are divided into four categories with a 'weight' assigned to each, representing what we think is an appropriate relative importance. Each feature is given a relative score against the 'weight'. The 'weight' also represents the maximum score that can be assigned to a tool for a given category. The proposed criteria categories and 'weights' are listed below:

- Tool features — (total 80%)
  - Network models supported — 15%
  - Modeling capability — 20%

- Modeling input data capability — 15%
- Optimization capability — 20%
- Reporting capability — 10%
- Tool ease of use — 5%
- Vendor support — 10%
- Cost — 5%

PILOT's recommendations and presentations to USDA will be based upon the results of this ranking.